MICROCONTROLLER BASED AUTOMATIC PLANT WATERING SYSTEM

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ABSTRACT

Integrated Gardens of Islamic State University (UIN) Sunan Gunung Djati Bandung is a garden that is under the auspices of the Faculty of Science and Technology UIN Sunan Gunung Djati Bandung. In the normal watering plants found several problems including land managers sometimes forget to do the watering of plants according to the schedule properly. Of these problems, we need a system that can perform scheduling watering plants, watering plants perform remotely, perform automatic watering soil moisture sensor based on the temperature of the soil, and it can also check the level of soil moisture and soil temperature. This study intends to make an automatic plant watering system based on microcontroller. Board microcontroller used is arduino uno. In arduino uno connect two sensors, the sensor soil moisture and soil temperature sensor. Both of these sensors are used to detect the level of soil moisture and soil temperature. The level of soil moisture and soil temperature will be used as input parameters for the system to determine the appropriateness of watering the plants do. As a media remote control, made also a mobile application with the android operating system. Construction of microcontroller based automatic plant watering systems are expected to assist in scheduling watering, watering from a distance, watering based on the level of soil moisture and soil temperature, and check the level of soil moisture and soil temperature.

Keywords: Watering, Microcontroller, Android

1. PRELIMINARY

Integrated Gardens State Islamic University (UIN) Sunan Gunung Jati Bandung is a garden that is under the auspices of the Faculty of Science and Technology UIN Sunan Gunung Jati Bandung. The gardens located at Road No. 105 AH Nasution Cibiru. In addition to functioning as green spaces, gardens Integrated UIN is also used as a place of practical work and research, particularly by students of the Department of Agro-technology. In the garden with an area of 500 m2 with an estimated 100 species of plants, consisting of fruit trees, vegetables, medicinal, and ornamental. The garden daily cared for by the land managers. Every day in the garden watering the plants 2 times, the morning and afternoon. In the normal watering plants found several problems including land managers sometimes forget to do the watering of plants according to the schedule properly. Besides the land managers sometimes have activity in other places so it can not be in the garden to plant watering and checking the condition of the soil. This can result in water shortages plants so the plants wither and even die. Another issue is watering the plants did not consider the level of soil moisture. Excessive watering of course cause wastage of water consumption. Soil conditions became too wet it can cause the plants susceptible to fungus and rot. Of these problems, we need a system that can perform scheduling watering plants, watering plants perform remotely, perform automatic watering soil moisture sensor based on the temperature of the soil, and it can also check the level of soil moisture and soil temperature hot.

This study intends to make an automatic plant watering system based on microcontroller. Board microcontroller used is arduino uno. In arduino uno connect two sensors, the sensor
soil moisture and soil temperature sensor. Both of these sensors are used to detect the level of soil moisture and soil temperature. The level of soil moisture and soil temperature will be used as input parameters for the system to determine the appropriateness of watering the plants do. The types of plants that became the object of research is Aglaonema. Aglaonema can grow well at a temperature range of 28-30 ° C during the day and 20-22 ° C at night [1]. While soil moisture is ideal for Aglaonema humidity in the range of 50-75% [2]. Besides connecting with two sensors, arduino is also connected to a relay. Relay serves as an electric switch to turn on and off an electric solenoid valve or faucet.

As a media remote control, made also a mobile application with the android operating system. This application can perform scheduling watering, watering from a distance, watering based on the level of soil moisture and soil temperature, and check the level of soil moisture and soil temperature. Android applications connected with arduino uno via command sms (Short Message Service). For arduino uno pinned it on a device

called a GSM module, which functions to connect arduino uno GSM network.

Sms chosen as a means of connecting between android app and arduino uno for the integrated plantation area is no network for internet. By using intermediary sms that network coverage is broader than the Internet network, the communication between the android application and arduino uno can still be done at the venue.

1.1 Microcontroller

A microcontroller is a functional computer system on a chip. It contains a processor core, memory (a small amount of RAM, program memory, or both), and input and output equipment. In other words, the microcontroller is a digital electronic device that has inputs and outputs as well as control with a program that can be written and erased in a special way, how the actual microcontroller to read and write data. Microcontroller is a chip inside the computer that is used to control electronic devices, which emphasize efficiency and cost effectiveness. Is literally can be called "little control" where an electronic system which previously was often require supporting components such as TTL and CMOS IC can be reduced / minimized and ultimately centralized and controlled by the microcontroller.

1.2 Arduino

Arduino adalah sebuah platform open source (sumber terbuka) yang digunakan untuk membuat proyek-proyek elektronika. Arduino terdiri dari dua bagian utama yaitu sebuah papan sirkuit fisik (sering disebut juga dengan mikrokontroler) dan sebuah perangkat lunak atau IDE (Integrated Development Environment) yang berjalan pada komputer. Perangkat lunak ini sering disebut Arduino IDE yang digunakan untuk menulis dan meng-upload kode dari komputer ke papan fisik (hardware) Arduino. Arduino terdiri dari dua bagian yaitu hardware dan software [3].

1.3 Arduino Uno (R3)

Arduino is an open source platform (open source) used to make electronics projects. Arduino is composed of two main parts: a physical circuit board (often called microcontroller) and a software or IDE (Integrated Development Environment) that runs on the computer. This software is often called the Arduino IDE used to write and upload the code of the computer board to physical (hardware) Arduino. Arduino is composed of two parts: hardware and software [3].

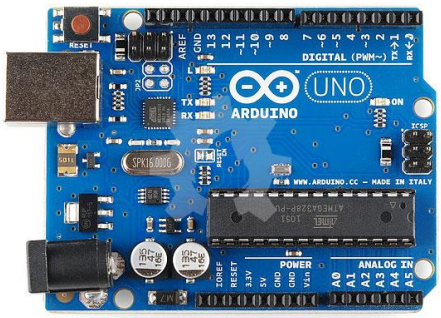


Figure 1. The Arduino Uno board

1.4 Temperature Sensor DS18B20

DS18B20 temperature sensor is an electronic component that can capture changes in ambient temperature and then convert them into electrical quantities. This sensor is a digital sensor that uses 1 wire to communicate with the microcontroller.



Figure 2. Temperature Sensor DS18B20

1.5 Soil Moisture Sensor YL-100

Soil Moisture Sensor (Soil Moisture) YL-100 is a sensor that can detect soil moisture. The sensor consists of two probes to pass current through the ground, then read the resistance to get the moisture level. The more water to make the soil more easily conduct electricity (minor resistance), while the dry soil is very difficult to conduct electricity (major resistance) [3].

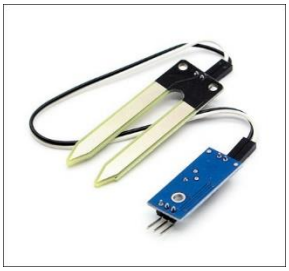


Figure 3. Soil Moisture Sensor

1.6 Relay

Relay is a switch (Switch) are operated electrically and is an Electromechanical components (Electromechanical), which consists of two main parts namely Electromagnetic (Coil) and Mechanical (set Contacts Switches / Switch). Principle of Electromagnetic Relay use to move the switch contacts so that the electric current is small (low

power) can conduct electricity with a higher voltage. For example, with the use of Electromagnetic Relay 5V and 50 mA are moving Armature Relay (which serves as a switch) to conduct electricity 220V 2A [3].



Figure 4. Relay

1.7 Solenoid Valve

Solenoid valve is a valve that is driven by electric energy, has a coil as a vehicle that serves to drive the piston can be driven by current AC and DC, solenoid valve or valves (valve) solenoid having outlet, inlet and hole exhaust, inlet, function as terminal / point of entry or supply of fluid, and outlet, serves as a terminal or a fluid exit connected to the load, while the exhaust hole, serves as a conduit to remove fluid that is trapped when the piston moves or move position when the solenoid valve work.



Figure 5. Solenoid Valve

1.8 GSM Modul - SIM900A

SIM900A SIM module is used in this study. Module SIM900 GSM / GPRS is a section that serves to communicate between the microcontroller board arduino with Mobile. ATCommand is a command that can be given modem GSM / CDMA as to send and receive data based on GSM / GPRS, or send and receive SMS. SIM900 GSM / GPRS is controlled via AT commands (GSM 07:07, 07:05, and SIMCOM) [5].



Figure 6. GSM Module - SIM900A

1.9 Android

Android is a mobile device in the operating system for mobile phones based on Linux. Android is an OS (Operating System) Mobile that grow amid developing other OS today. Other OS such as Windows Mobile, i-Phone OS, Symbian, and much more. However, the existing OS is running with core apps built prioritize their own without seeing the great potential of third-party applications. Therefore, the limitations of third-party applications to obtain the original data phones, communication between processes and the limited distribution of third-party applications on their platform [6].

1. RESEARCH CONTENT

2.1 Analysis System Ongoing

Watering system conducted at the Integrated Gardens UIN Sunan Gunung Jati Bandung is still done manually. Land managers do watering using a hose every morning and evening, except when the ground is wet due to rain, then watering is not done.

2.2 Analysis of Architecture Design System

The system will be built is an automatic plant watering system based on microcontroller which will be connected to a mobile application andoid via sms sending commands. The design of the system to be built can be seen in the following figure:



Figure 7. Architecture-Based System Design Watering Plants Android

Berikut penjelasan tahapan-tahapan proses dari arsitektur perancangan sistem yang akan dibangun:

1. Aplikasi android mengirimkan perintah berupa kode sms melalui BTS (Base Transceiver Station).
2. BTS meneruskan perintah sms tersebut kepada GSM Module.
3. Arduino memproses perintah sms yang diterima oleh GSM Module untuk melakukan keputusan.
4. Arduino menyalakan relay.

5. Relay yang menyala akan menyambungkan arus listrik untuk membuka solenoid valve (kran elektrik).
6. Solenoid Valve mengalirkan air menuju sprinkler.
7. Sprinkler menyemprotkan air menuju tanaman.
8. Sensor kelembaban membaca tingkat kelembaban tanah.
9. Sensor suhu membaca tingkat suhu tanah.
10. Tingkat kelembaban tanah yang dibaca sensor kelembaban akan diproses oleh arduino untuk melakukan keputusan.
11. Tingkat suhu tanah yang dibaca sensor suhu akan diproses oleh arduino untuk melakukan keputusan.
12. Arduino mengirimkan notifikasi dalam bentuk sms.
13. GSM Modul mengirimkan notitikasi dalam bentuk sms tersebut melalui BTS.
14. BTS meneruskan notifikasi sms ke handphone android, yang akhirnya akan tampil di aplikasi android.

2.3 Analysis Hardware

Analysis of minimum hardware requirements that are used to implement this application can be seen in Table 1.

Table 1. Minimum Hardware Requirements Specification

No.	Hardware	Specification
1	Operating system	ICS
2	Ram	512 MB
3	Internal memory	1 GB
4	processor	800 MHz

While the hardware specifications recommended to use this application, namely for Users can be seen in Table 2.

Table 2. Specifications Hardware Requirements Recommendations

No.	Hardware	Specification
1	Operating system	jelly Bean
2	Ram	1 GB
3	Internal memory	4 GB
4	processor	1 GHz

2.4 Arduino Uno R3

Arduino uno adalah papan mikrokontroler berbasis ATMEGA328 yang memiliki 14 pin digital input/output, 6 diantarnya digunakan sebagai output Pulse Width Modulation (PWM), 6 input analog, clock speed 16MHz, koneksi USB, Jack listrik, header ICSP, dan tombol reset. Board ini menggunakan daya yang terhubung ke computer dengan kabel USB atau daya external dengan adapator AC-DC atau baterai.

Arduino Uno adalah pilihan yang baik untuk pertama kali atau pemula yang ingin mengenal Arduino. Di samping sifat nya yang reliabel juga harga yang terjangkau.

Table 3. Spesifications Arduino Uno R3

Microcontroller	ATMEGA328
Operating Voltage	5V
Input Voltage	7-12V
Limit Input Voltage	6-20V
Digital I/O Pin	14(6 pin PWM)
Analog Input Pin	6
DC Current Per I/O Pin	40mA
Arus DC untuk Pin 3,3V	50mA
Flash Memory	32 KB (ATmega328), 0,5 KB bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock	16MHz

Arduino can be enabled via a USB connection or external power supply. Power source is selected automatically. External resources (Non-USB) can be derived from AC to DC adapter or battery. The adapter can be connected by plugging a Power Jack, can also be connected to the power pin (Gnd and Vin).

Arduino Uno board can operate on external supply of 6 to 20 volts. If supplied less than 7V. Although the 5V pin may be less than 5V supply, the board may be unstable. If using more than 12V teganggan, regular voltage can heat and damage the board. The range that is suggested is 7 to 12 volts.

2.5 Analysis of User Needs

User analysis is a provision that the user can mengoprasionalkan or run
This automatic plant watering system, while the p enggunaprovisions are as follows:

1. Users can operate the device Android.
2. Android device that the user used to be filled pulse.
3. Users are encouraged aged 12 to 60 years.

With the characteristics of the above it can be concluded that the user can use this application should at least understand or Android device can run Android applications.

2.6 Use Case Diagram

Use case diagram is a diagram showing the functionality of a system or class and how these systems interact with the outside world and explain the system functionally apparent to users.

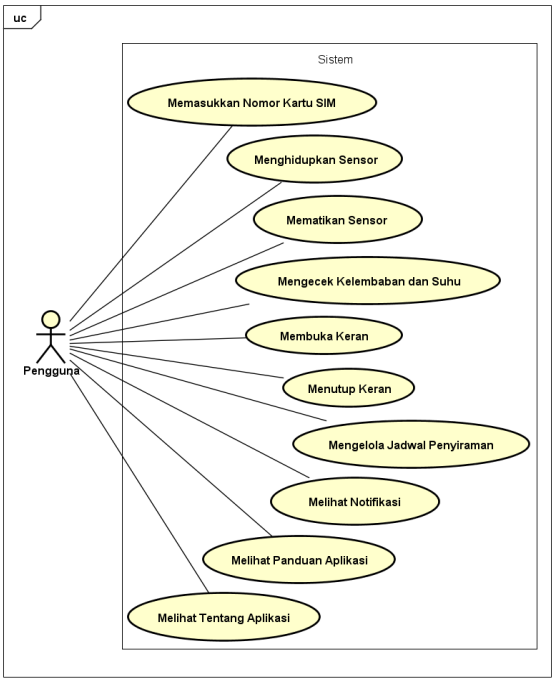


Figure 8. Use Case Diagram

2.7 Activity Diagram

Activity diagram modeling the workflow or workflow of the order of activities in a process that refers to the existing use case diagram.

2.7.1 Activity Diagram Turn Sensor

Here is an activity diagram Turn Sensor.

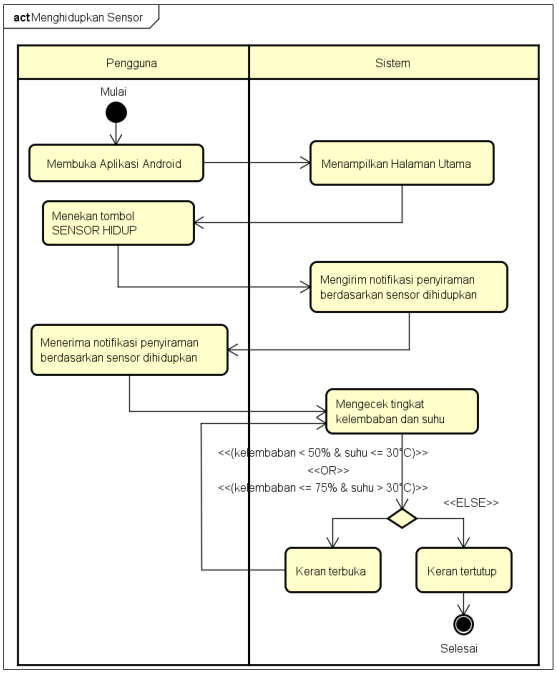


Figure 9. Activity Diagram Turn Sensor

2.7.2 Activity Diagram Deadly Sensor

Here is an activity diagram toggles Me Sensor.

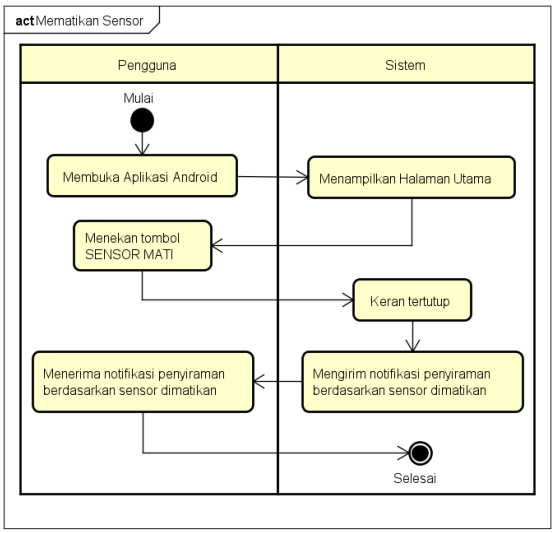


Figure 10. Activity Diagram Deadly Sensor

2.7.3 Activity Diagram Checking Humidity and Temperature

Here is an activity diagram Checking Humidity and Temperature.

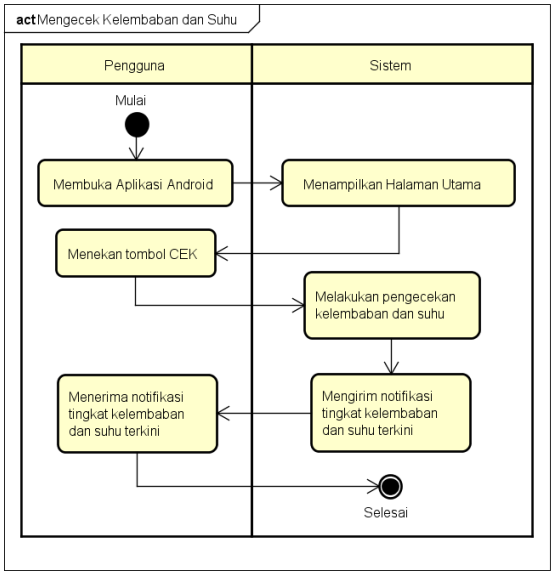


Figure 11. Activity Diagram Checking Humidity and Temperature

2.7.4 Activity Diagram Opens Faucet

Here is an activity diagram Opens Faucet.

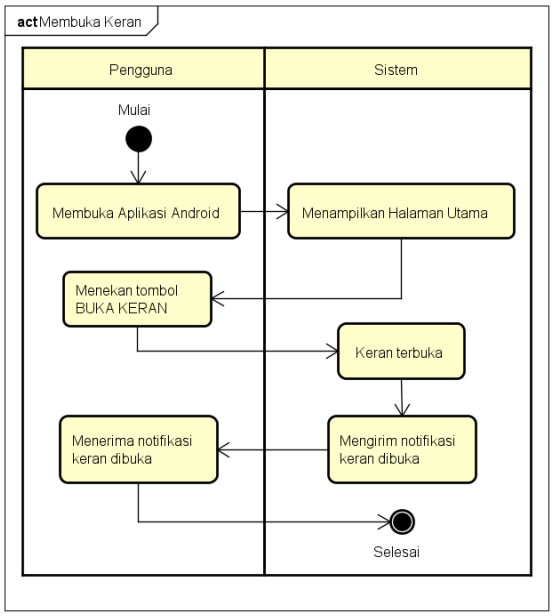


Figure 12. Activity Diagram Opening the taps

2.7.5 Activity Diagram Closing Taps

Here is an activity diagram Closing Taps.

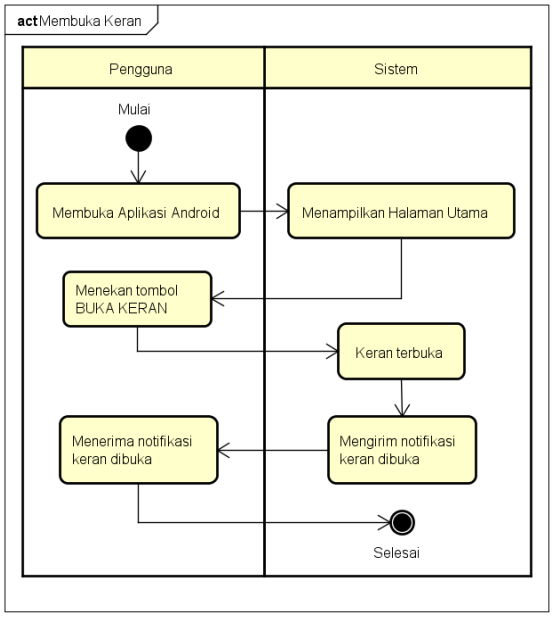


Figure 13. Activity Diagram Closing Taps

2.7.6 Activity Diagram Managing Watering Schedule

Here is an activity diagram Managing Watering Schedule.

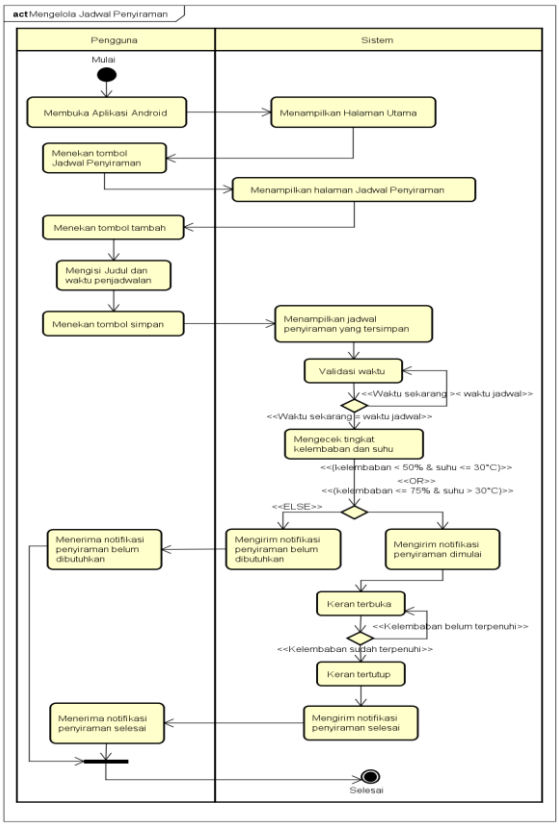


Figure 14. Activity Diagram Managing Watering Schedule

2.7.7 Activity Diagram View Alert

Here is an activity diagram Viewing Alert.

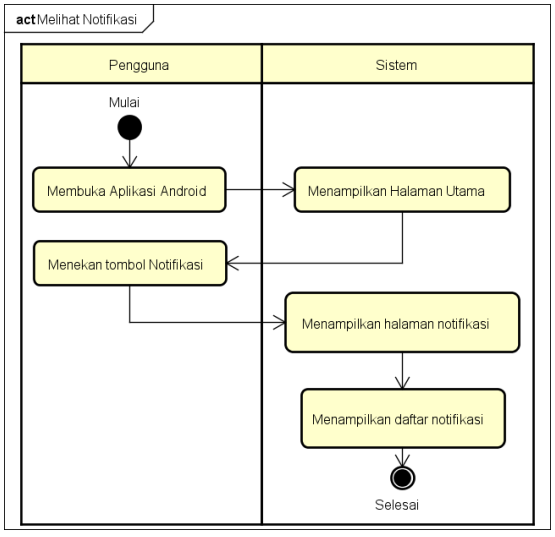


Figure 15. Activity Diagram View Alert

2.8 Designing Interfaces

Interface (interface) is a form of display of the programs that appear on android devices aimed at giving an overview of applications to be built, so that it will facilitate the application pengimplementasikan appropriate screen size and simplify the creation of applications.

2.8.1 Interface Design Guide Main

The design interface is the main page where the user can control the desired device.

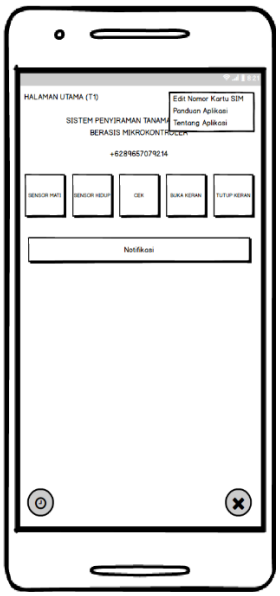


Figure 16. Interface Home

2.8.2 Interface Design Watering Schedule page

Interface design watering schedule page where the user can perform time scheduling watering.

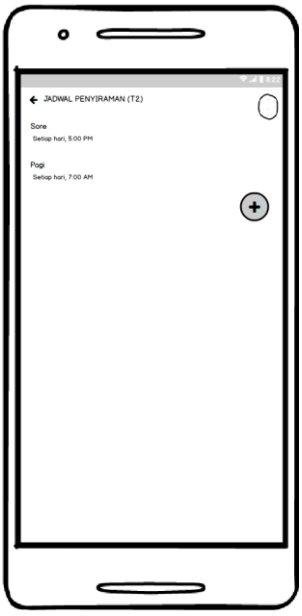


Figure 17. Interface page Watering Schedule

2.8.3 Design 8.3 Interface Page Notifications

Interface design notification page where the user can view the notification and history watering.



Figure 18. Notification Schedule page interface

2.9 Interface Implementation

Implementation of the interface contains the exposure of any part of the automatic plant watering system based on microcontroller built as the layout of each interface as below:

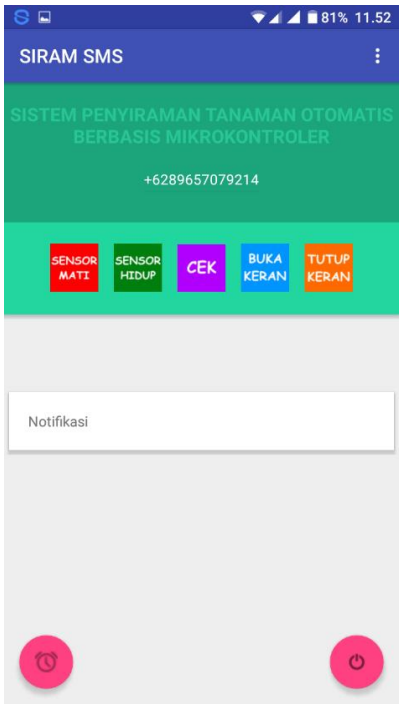


Figure 19. Interface Home

2. CLOSING

3.1 Conclusions

Based on the results obtained from studies conducted in the preparation of the final project refers to the purpose of research, it can be concluded:

1. Users can perform scheduling watering plants.
2. Users can perform remotely watering plants.
3. Users can perform automatic plant watering based on soil moisture sensor and soil temperature.
4. Users can check the level of soil moisture and soil temperature hot.

3.2 Suggestions

As for suggestions for future system improvements are:

1. The need for backup power to the system so that the system can continue to run well when the main power supply off.
2. Watering tools and applications can connect by using the Internet network.

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